

4. SYSTEM ANALYSIS

4.1 WATER RIGHTS ANALYSIS

The Utility has one water right for surface water diversion from the Cowlitz River for municipal use. Maximum instantaneous flow is 0.50 cubic feet per second (cfs) or about 224 gallons per minute (gpm). A maximum annual volume is not specified.

The water right is Surface Water Certificate No. 9616. The original priority date is November 9, 1961; but the point of withdrawal along the Cowlitz River was slightly changed in 1972 and the priority date changed to November 21, 1972. Water rights issued in the 1960s and 1970s commonly did not include an annual withdrawal amount. Copies of the water right documents are in Appendix C.

Table 4.1 compares the existing water rights with the existing capacity of the system. The source capacity considered the limiting factors of the river pump (225 gpm), raw water pump station (one pump at 190 gpm and two pumps running produce 225 gpm), , and water treatment plant (two 100 gpm treatment units). The source capacity was determined to be 200 gpm. Table 4.1 shows that the system is operating within their water right.

TABLE 4.1 – WATER RIGHTS SUMMARY				
Source	Certificate	Instantaneous Withdrawal		
		Water Right (gpm)	Existing Capacity (gpm)	Surplus (+) or Deficit (-) (gpm)
Cowlitz River	9616	224	200	24

Tables 4.2 through 4.4 show the status of existing, forecasted 6-year and forecasted 20-year water rights. The tables show that the water right is not the limiting factor for system operation and growth.

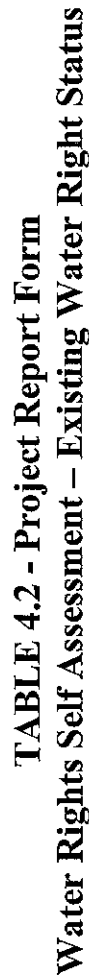
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TABLE 4.3 - Project Report Form
Water Rights Self Assessment – Forecasted 6-Year Water Right Status

Permit Certificate or Claim #	Name of rightholder or claimant	Priority Date	Source Name/Number	Primary or supplemental	Existing System Capacity - based on water right limits		Projects Production/withdrawal with New Project On-line		Projected System Capacity Status (excess or deficiency of water rights)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificate No. 9616	Town of Vader	11/21/72	Cowlitz River	Primary	224 gpm	N/A	200 gpm	N/A	24 gpm	N/A
Claims										
1.										
2.										
3.										
4.										
Total										
Inter tie Name/Identifier		Name of Purveyor Providing Water			Existing Limits on Inter tie Water Use		Projected Production/Withdrawal with New Project On-line		Current Inter tie Supply Status (Excess/Deficiency)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (qi)	Maximum Annual Volume (Qa)
1.										
2.										
3.										
4.										
TOTAL		*****	*****	*****	*****	*****				

TABLE 4.4 - Project Report Form
Water Rights Self Assessment – Forecasted 20-Year Water Right Status

Permit Certificate or Claim #	Name of rightholder or claimant	Priority Date	Source Name/Number	Primary or supplemental	Existing System Capacity - based on water right limits		Projects Production/withdrawal with New Project On-line		Projected System Capacity Status (excess or deficiency of water rights)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificate No. 9616	Town of Vader	11/21/72	Cowlitz River	Primary	224 gpm	N/A	220 gpm	N/A	24 gpm	N/A
Claims										
1.										
2.										
3.										
4.										
Total										
Intertie Name/Identifier		Name of Purveyor Providing Water			Existing Limits on Intertie Water Use		Projected Production/Withdrawal with New Project On-line		Current Intertie Supply Status (Excess/Deficiency)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (qi)	Maximum Annual Volume (Qa)
1.										
2.										
3.										
4.										
TOTAL										

4.2 SOURCE CAPACITY

The water system receives water from a single surface water source, the Cowlitz River. DOH requires source production capacity to be equal to meet Maximum Day Demands (MDD). And the water rights must be sufficient to meet MDD and Average Day Demands (ADD). Since the source capacity of 200 gpm is less than the water right of 224 gpm, the source analysis will make comparisons to the source capacity at an 18-hour production day. Table 4.5 compares current and projected MDD and ADD values with the source capacity. The source capacity can adequately handle demands in the two planning horizons.

TABLE 4.5 – 18 HOUR SOURCE PRODUCTION CAPACITY ANALYSIS			
CATEGORY	BASE (2015)	6-YEAR (2021)	20-YEAR (2035)
Without Conservation (Table 3.14)			
Projected ERU and Demands			
ERU	420	503	694
ADD (gpd)	52,080	62,372	86,056
MDD (gpd)	96,600	115,690	159,620
Existing Source Capacity (gpd)	216,000	216,000	216,000
Source Surplus(+)/Deficiency (-) (gpd)	+119,400	+100,310	+56,380

Limiting Factor Determination Source Capacity Average Daily Demand

$$N=V_a/(365*ADD) = 216,000 \text{ gpd}/124 = 1742 \text{ ERUs}$$

Limiting Factor Determination Source Capacity Maximum Daily Demand

$$N=V_d/MDD = 216,000/230 \text{ gpd/ERU} = 939 \text{ ERUs}$$

4.3 STORAGE CAPACITY

Existing Effective Storage

The effective storage capacity in the reservoir is the volume available of being withdrawn at the rates and pressures required for water storage purposes. Generally, the effective storage is equal to the total storage minus operational and dead storage.

Table 4.6 summarizes the characteristics of the steel reservoir.

TABLE 4.6 – RESERVOIR CHARACTERISTICS	
Characteristic	Value
Nominal Capacity	250,000 gallons
Diameter	55 ft

Unit Volume	17,772 gal/ft
Overflow Elevation	328 ft
Source Call Elevation	326.5 ft
Minimum Operating Elevation	316 ft
Outlet Elevation	315 ft
Base Elevation	315 ft
Effective Storage Depth	10.5 ft
Effective Storage Volume	186,510≈186,500

The Total Storage (TS) is the volume between the base and overflow elevations. This volume is about 230,910 gallons.

$$TS = \pi \times 55^2/4 \times (328 \text{ ft} - 315 \text{ ft}) \times 7.48 \text{ gal/cf} = 230,908 \text{ gal} \approx 230,910 \text{ gallons}$$

The Operational Storage (OS) is the volume between the low and high water storage elevations set to control system pumps. This volume is about 26,640 gallons.

$$OS = \pi \times 55^2/4 \times (328 \text{ ft} - 326.5 \text{ ft}) \times 7.48 \text{ gal/cf} = 26,643 \text{ gal} \approx 26,640 \text{ gallons}$$

Dead Storage (DS) is the last foot of water in the reservoir because the reservoir should not be drawn down within a foot of the outlet pipe elevation. This volume is about 17,760 gallons.

$$DS = \pi \times 55^2/4 \times (1 \text{ ft}) \times 7.48 \text{ gal/cf} = 17,762 \text{ gal} \approx 17,760 \text{ gallons}$$

The Effective Storage is (ES) Total Storage minus Operational Storage and Dead Storage. This volume is about 185,790 gallons.

$$ES = TS - OS - DS = 230,910 - 26,640 - 17,760 = 186,510 \text{ gallons.}$$

The system has an additional 24,220 gallons available from the clearwell. The clearwell is a 61,650 gallon (29 ft x 20.33 ft x 14 ft) concrete reservoir beneath the treatment plant that is used as a clearwell to provide adequate contact time. The remaining 37,433 gallons is needed to provide adequate chlorine contact time. If needed, about 24,220 gallons of additional storage is available in the clearwell.

This brings the total available storage to 186,510 + 24,220 gallons=**210,730 gallons**

Equalizing Storage

Equalizing storage is typically used to meet diurnal demands that exceed the average daily and peak day demands. The volume of equalizing storage required depends on peak system demands, the magnitude of diurnal water system demand variations, the source production rate, and the mode of system operation. Sufficient equalizing storage must be provided in combination with available water sources and pumping facilities such that peak system demands can be satisfied.

Equalizing storage is calculated using the following equation from Table 9-1 of the DOH Water System Design Manual:

$$VES = (PHD - QS) \times 150 \text{ minutes}$$

Where VES = Equalizing Storage component (gallons)

PHD = Peak Hourly Demand

(gpm)

QS = Total Source of Supply Capacity, excluding emergency sources (gpm) = 200 gpm.

Equalizing storage is zero because the peak hour demand is less than the source capacity of 200 gpm for all but the projected water demand for the 20 year forecast. For forecast year 20, $VES = (231 \text{ gpm} - 200 \text{ gpm}) \times 150 = 4,650$ gallons.

Standby Storage

Standby storage is provided to meet demands in case of a system failure such as a power outage, an interruption of supply or a break in the major transmission line. The amount of emergency storage should be based on the reliability of supply and pumping equipment, standby power sources, and the anticipated out of service length of time.

Standby storage is calculated using the following equation from Table 9-1 of the DOH Water System Design Manual:

$$VBS = 2 \text{ days} \times ADD \times N$$

Where VBS = Total standby storage component (gallons)

ADD = Average daily demand per ERU (gpd/ERU)

N = Number of ERUs.

Table 4.7 lists the standby storage volumes for existing and the two projected planning horizons.

Fire Suppression Storage

Fire suppression storage is provided to ensure that the volume of water required for firefighting is available. Fire suppression storage also reduces the impact of firefighting on distribution water system. The amount of water required for firefighting purposes is specified in terms of rate of flow in gpm and an associated duration. Fire flows must be provided at a residual water system pressure of at least 20 psi.

Fire suppression storage is calculated using the following equation 9-4 of the DOH Water System Design Manual:

$$\begin{aligned} FSS &= FF \times T \\ &= 750 \text{ gpm} \times 30 \text{ minutes} = 22,500 \text{ gallons} \end{aligned}$$

Where FSS = Fire suppression storage

FF = Required fire flow rate (gpm) as specified by local fire protection authority or under WAC 246-293-640 whichever is greater.

T = Duration (minutes)

Storage Capacity Analysis

Table 4.7 lists the equalizing and standby storage volumes for existing and the two projected planning horizons (6-year, 20-year). The projected demands and ERU values are from Table 3.14. The values with no conservation are used.

TABLE 4.7 – PROJECTED STORAGE CAPACITY REQUIREMENTS				
CAPACITIES	2015 (gallons)	2021 (gallons)	2035 (gallons)	Limiting Factor Determination
ERU	420	503	694	730
EQUALIZING STORAGE	0	0	4,650	6000
STANDBY STORAGE	104,160	124,744	172,112	181,040
FIRE SUPPRESSION	22,500	22,500	22,500	22,500
TOTAL	130,960	138,710	199,262	209,540
EFFECTIVE STORAGE	210,730	210,730	210,730	210,730
AVAILABILITY/DEFICIT	+79,770	+72,020	+11,468	

The storage capacity can meet the projected 6-year and 20-year planning horizons. The projected water demands used a loss value of 10% as derived from the water balance analysis using data outlined in Table 3.10 and projecting the reduced loss based on the major repair of August 4, 2014. If non-revenue losses can be further reduced, the storage capacity can have increased availability.

Maximum ERUs based on Capacity Related Storage ~ 730 ERUs

4.4 DISTRIBUTION SYSTEM ANALYSIS

4.4.1 Hydraulic Modeling

As required by DOH, the water system was analyzed using a computer hydraulic model. The distribution system was analyzed and deficiencies were identified for two conditions: peak hour demands (PHD) and maximum day demands (MDD) plus fire flow. All modeling calculations were performed using EPANET.

Hydraulic models require a configuration of the system and assignment of specific system elements such as pipes, nodes and reservoirs. The system was modeled as 65 nodes, 85 pipes and 1 tank. The system has no operable PRV. A schematic map of the system is in Appendix D.

The layout of the water system was recreated in the computer model using an updated system map. This system map was developed by the Utility in 2010 using as-built plans, field

investigations, operator lore, and the 2008 WSP. The system map was updated in 2013 to include the water system improvements made by the Utility in 2012.

Chapter 3 presents information on water demands for the existing system and for two planning horizons (2020, 2034). For the model, the demand forecast shown in Table 3.14 under the “without conservation” was used to determine the demand in the service area.

4.4.2 Demand Allocation

Demand allocation was determined by the number and type of services at a specific node. The number of customers and type of service customer were assigned at either the nearest or downstream node of the particular water main segment. The spatial distribution of demand was allocated across every node with the exception of nodes that were located on a transmission main, and near the tank. The total number of customers were then totaled and compared to the number of active and inactive service connections. There are about 402 available water service connections as confirmed by the presence of existing service meter boxes.

After the existing demand allocation was conducted, it was used as the basis for the allocation of the two planning horizons: 6-year (2020); and 20-year (2034). Future non-residential demands at specific nodes in the non-residential land use zones were adjusted. Future residential demands were adjusted using a multiplier of 1.1 ($=370/341$) and 1.3 ($=437/341$) for 2020 and 2034, respectively. The derivation of the multiplier is based on the projected number of residential ERU with 341, the existing number of residential ERU.

The water demand values shown in Table 3.14 were then used to compute the demand at each junction node. The demand used is the total demand which is the sum of authorized consumption and non-revenue water loss.

4.4.3 Model Calibration

The calibration of a hydraulic model provides a measure of assurance that the model is accurate and representative of the actual system. The model was calibrated using field data from fire hydrant tests obtained at various locations in the system. Readings of static pressures, fire flows and residual pressures were taken on June 5, 2014. The system conditions at the time of each test were recorded. The tank water level was full at the time of hydrant testing. Table 4.8 summarizes the test locations and associated node numbers.

TABLE 4.8 - HYDRANT TEST READINGS		
TEST #	NODE #	LOCATION
1A	59	9 th /E St
1B	86	9 th /G St
2A	76	10 th /A St
2B	75	10 th /B St
3A	29	6 th /Annonen
3B	25	6 th /Main
4	85	8 th /I St
5A	111	EVD/Spring Ct
5B	109	EVCC

Using the system conditions for each hydrant test, the hydraulic model was used to generate static and residual pressures at the measured hydrant flow rates. The total system demand at the time of the hydrant tests was assumed to be the average day demand for 2013 with a full reservoir. Static pressure readings were compared to model output from this simulation. Residual pressure readings were compared to model output from placing an added demand at the test hydrant locale equal to the field measured hydrant flow rate.

The field results were then compared to the model simulations described above. System pressures and water flow rates are dependent upon the friction loss characteristics for each pipe. These characteristics in the model are set by model parameters such as pipe type, roughness coefficients, pipe lengths and elevations. These parameters were adjusted through an iterative process until the model output approximated the field measured data. The model output was compared with the field measurements for static pressure and residual pressure. The comparison is summarized in Table 4.9.

TABLE 4.9 – MODEL CALIBRATION RESULTS								
TEST #	NODE #	FLOW (gpm)	STATIC PRESSURE (gpm)			RESIDUAL PRESSURE (gpm)		
			FIELD	MODEL	DIFFERENCE	FIELD	MODEL	DIFFERENCE
1A	59		54	50	4	-	-	-
1B	86		52	49	3	-	-	-
1B, Fire	86	1000	-	-	-	40	45	5
2A	76		82	78	4	-	-	-
2B	75		70	71	1	-	-	-
2B, Fire	75	1250	-	-	-	62	66	4
3A	29		84	81	3			
3B	25		70	72	2			
3B, Fire	25	1200	-	-	-	62	67	5
4	85	-	44	42	2	-	-	-
5A	111		50	47	3			
5B	109		50	46	4			

Hydraulic models are required to be within 5 psi of measured pressure readings for long range planning according to the DOH Design Manual, Table 8-1. Calibration of the model produced results within 4 psi of the field data for static pressure, and within 5 psi of the field data for residual pressure. Detailed analyses of the model input and calibration simulations are in Appendix D.

4.4.4 Model Scenarios

After calibration of the model, hydraulic analyses were made for six scenarios. The scenarios are listed in Table 4.10.

TABLE 4.10 – MODELING SCENARIOS		
DESCRIPTION	DEMAND	PURPOSE
Existing, Peak Hour	2014 PHD	Evaluate system
Existing, Fire Flow	2014 MDD plus fire flow	Evaluate system

Plan Year 6 (2020), Peak Hour	2020 PHD	Evaluate system performance and develop CIP for Plan Year 6 peak hour conditions
Plan Year 6 (2020), Fire Flow	2020 MDD plus fire flow	Evaluate system performance and develop CIP for Plan Year 6 fire flow conditions
Plan Year 20 (2034), Peak Hour	2034 PHD	Evaluate system performance and develop CIP for Plan Year 20 peak hour conditions
Plan Year 20 (2034), Fire Flow	2034 MDD plus fire flow	Evaluate system performance and develop CIP for Plan Year 20 fire flow conditions

4.4.5 Peak Hour Demand Results

In accordance with WAC 246-290-230, a minimum pressure of 30 psi must be maintained at all customer connections under PHD conditions. The system was modeled under existing, 2020 and 2034 peak hour demand conditions. The pressures from these scenarios are in Appendix D. The system is capable of meeting the minimum pressure requirements.

4.4.6 Fire Flow Analysis Results

A minimum of 20 psi must be maintained for fire flows under MDD conditions. Minimum fire flows were obtained from WAC 246-293-640 and confirmed by the Lewis County Fire Marshall as being the minimum standard for Lewis County in this area. Although the existing customer base is primarily residential, the City of Vader has some lands designated as commercial so fire flows of 750 gpm were used. Table 4.11 shows fire flows at all of the hydrant locations in the system. The system is able to meet fire flows for the 6-year and 20-year planning horizons.

To meet higher fire flows in the EVCC area, the small 2-inch and 4-inch mains must be replaced with larger piping.

TABLE 4.11 – AVAILABLE FIRE FLOW					
NODE #	HYDRANT LOCATION	FIRE FLOW GOAL (gpm)	AVAILABLE FIRE FLOW (gpm)		
			2014	2020	2034
4	6 th /G St	750	2600	2600	2600
12	6 th /D St	750	2200	2200	2200
19	6 th /B St	750	2200	2200	2200
22	5 th /A St	750	2200	2200	2200
25	6 th /Main	750	2200	2200	2200
29	6 th /Annonen	750	2200	2200	2200
30	7 th /Annonen	750	2200	2200	2200
32	SR506/Winlock Vader Rd	750	1000	1000	1000
35	7 th /A St	750	2200	2200	2200
37	7 th /B St	750	2200	2200	2200
39	7 th /E St	750	2200	2200	2200
43	8 th /E Alley	750	2100	2100	2100

45	8 th /C St	750	2100	2100	2100
50	9 th /A Alley	750	2100	2100	2100
54	9 th /B St	750	2100	2100	2100
59	9 th /E St	750	2100	2100	2100
68	9 th /G St	750	2000	2000	2000
69	10 th /F St	750	2100	2100	2100
70	10 th /E St	750	2100	2100	2100
72	10 th /D St	750	2100	2100	2100
75	10 th /B St	750	2100	2100	2100
76	10 th /A St	750	2100	2100	2100
85	8 th /I St	750	1800	1800	1800
86	9 th /G St	750	1900	1900	1900
109	Enchanted Valley Country Club (EVCC)	750	750	750	750
111	EVD N/Spring Ct	750	1000	1000	1000

4.5 SUMMARY OF SYSTEM CAPACITIES

The capacity of the system is defined by the limiting capacities of several system elements. These elements are summarized in the Table 4.12.

TABLE 4.12 – WATER FACILITY CAPACITIES	
FACILITY	CAPACITY
Source @ 18 hour Pump Rate	216,000 gpd
Source @ 24 hour Pump Rate	288,000 gpd
Water Rights, Qi	224 gpm
Intake Pumping Capacity	225 gpm
Treatment Plant	200 gpm
Storage from Tank and Clearwell	210,730 gallons (=186,510 tank + 24,220 clearwell)

A comparison was made between the facility capacities and the forecasted water demands provided in Table 3.14. For brevity, the forecasted water demands with no water conservation are provided in Table 4.13 since conservation measures would reduce projected water demands.

TABLE 4.13 – WATER DEMAND WITH NO CONSERVATION				
SCENARIO	ERU	WATER DEMAND WITH NO CONSERVATION		
		ADD	MDD	PHD
BASE (2015)	420	52,080 gpd	96,600 gpd	175 gpm
6-YEAR (2021)	503	62,372 gpd	115,690 gpd	182 gpm
20-YEAR (2035)	694	86,056 gpd	159,620 gpd	231gpm

The analysis shows that the system has the facility capacity to meet projected demands. This adequacy is based on the following assumptions:

- Continuation of the water loss rate as outlined in Table 3.11 (10%) and used in forecasted demands in Table 3.14.
- No significant change in the number and usage habits of residential customers
- No expanded change in water usage from primarily residential to industrial and commercial.
- No change in the ERU factor of 124 gpd/ERU.

Although the water loss at this time appears to be sustainable below the 10% target threshold, the 3-year average is 27%, therefore, a water use efficiency program is outlined in Chapter 5 to further reduce non-revenue water loss to comply with DOH regulations and in the event water loss increases. In either scenario, the System can adequately meet future demands.

Water main improvement projects are outlined in Chapter 9 and were analyzed with the hydraulic model. A discussion of the priority assessment and of the utility's philosophy of individual capital improvement projects is provided in Chapter 9.

TABLE 4.14 Limiting Factor Determination of System Capacity ERU			
Source/Production Limit	216,000 gpd	230 gpd/ERU (MDD)	939 ERU
Capacity Related Storage Limit	ES+SB+FSS = 209,540	Eff. Storage = 210,730	730 ERU
System Limit	i.e. PHD produces < 30 psi		>1000 ERU
Water Right Limit	224 gpm	230 gpd/ERU	1402
Service Area Limit	Density based on Zoning	Figure 3.1	>2,500
20-Year Planning Horizon			694 ERU

TABLE 4.15 CURRENT WATER SYSTEM STATUS	
Current ERUs	420
ADD	124 gpd/ERU
MDD	230 gpd/ERU
Current PHD	175 gpm

Therefore, the limiting factor (other than the Planning Horizon is the Capacity Related Storage limit of 730 ERUs. Since this is above the 20 year planning horizon estimate of 694 ERUs:

As shown in Table 3.14, Lewis County is requesting approval for a total of 593 connections which, when taking projected water loss (10%) and authorized non-billed use into account translates to a total of 694 ERUs for the water system.

Appendix D shows the Hydraulic Analyses that were run for four different scenarios using EPANET.

Scenario 1 – ADD Demand of 54,233 gpd to show model calibration.

Scenario 2a - 2035 PHD – Nodes – This analysis shows that the system supports the 2035 Peak Hourly Demand of 231 gpm with only one node going below 30 psi. However that node is only a junction node in the software and there are no services off of that node. It does however illustrate that that the system cannot support development at a service elevation greater than elevation 258 and maintain minimum pressure of 30 psi.

Scenario 2b - 2035 PHD – Links – this report shows that there is no excessive velocity or head loss in any current pipe under 2035 PHD flows

Scenario 3 – Sets the demand multiplier to 0.01 (0 was not allowed by the software) which simulates the pressure in the system under static conditions – this scenario shows that the system pressures get above 80 psi in 2 main areas, downstream of Node 116 and Upstream of Node 107. These improvements have been put into the Capital Improvement Plan

Scenario 4 – System at 1000 ERUs – 315 gpm

VADER WATER SYSTEM CAPACITY

City and UGA		Land Area		Allowed Density under Code			Potential Dwelling Units under Zoning ¹	
Zone	City	UGA	Total	Estimate Developed ²	Minimum Density	Minimum Lot Size	Maximum Density	Housing Type for Maximum
CM	35.6	85.0	120.6		Residential Allowed Subject to standards of R2 and R3 zone. Commercial Anticipated		-	-
CS	27.9	19.4	47.4		Overlay zone. R1 zone typically underlying zone, so standards of R1 apply if the use is not a community facility		-	-
I	31.0		31.0		No residential allowed		-	-
R1	480.7	185.1	665.8	140.0	4	9,000	4.84	SFR
R2		97.2	97.2	45.0	4	9,000 (SFR) 12,000 (Duplex)	7.26	Duplex
R3	17.1	3.5	20.5	0.0	4	9,000 (SFR) 12,000 (Duplex) 17,000 (Eight Plex)	20.5	Eight Plex
Total	592.3	390.2	982.4	185.0			1,795.3	2,508.0
Rural County								
RRD 1-5			173.3	140.0	0	5 Acres	0.2	SFR
							-	5.0

¹ Assumes that Roads and Open Space will take up 25 percent of the site

² Calculated assuming that parcels within the City and UGA that were an acre or less in size and had a residential use were "developed"